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# Comparison of two experimental set-ups for electrodialytic removal of heavy metals and Cl from MSWI APC residues

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Air pollution control (APC) residues from municipal solid waste incineration (MSWI) is classified as hazardous waste and disposed of, although it contains potential resources. Due to the different flue gas cleaning system designs (wet or semi-dry), APC residues present distinct chemical and physical characteristics that can influence the remediation success and their possible reuse [1, 2]. The most problematic elements in MSWI APC residues are leachable heavy metals and salts. Studies have been made to optimise the removal of heavy metals from the highly alkaline MSWI APC residues by electrodialytic remediation in the stirred three compartment set-up (Fig. 1). To obtain high metal removal assisting agents or long remediation times to acidify the APC residues are needed [3, 4]. However, assisting agents and significant acidification of the APC residues drastically changes the properties of the matrix [5]. For reuse purposes, the aim for remediation should instead be reducing the heavy metal leaching and at the same time keeping the material characteristics, i.e. keeping the alkaline pH. This is a new approach for remediating APC residues.

A new two compartment electrodialytic set-up was recently filed for patenting [6]. The traditional three compartment electrodialytic cell and the new two compartment electrodialytic cell for treatment of particulate material suspensions are seen in Figure 1.

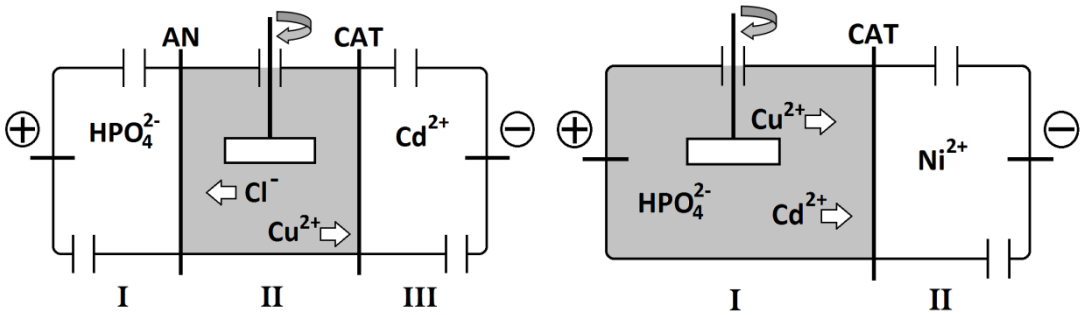


Figure 1. The experimental set-up of the three and two compartment electrodialytic cell. AN-anion exchange membrane, CAT-cation exchange membrane.

One of the advantages of the two compartment cell is the insertion of the anode directly into the suspension that should be treated, leading to faster acidification of the suspension by the electrode process than the acidification by water splitting at the anion exchange membrane in the three compartment cell. This would help reduce the remediation time of the treated material. This work presents a comparison of

electrodialytic treatment in the two cell set-ups under different experimental conditions, with the aim of reducing leaching of Cd, Cu, Cr, Pb, Zn and Cl from APC residues, to facilitate reuse of the APC residues.

Two APC residues were collected from wet and semi-dry flue gas cleaning systems from Danish waste incineration plants. Sixteen continuously stirred electrodialytic experiments were made, eight experiments in each cell type. In compartment II and I of the three and two compartment cell respectively, 100 g APC residue was mixed with 350 ml distilled water, keeping a fixed liquid to solid ratio of L/S 3.5 in all experiments. Experiments differed in the applied current density (0.1 or 1.0 $mA/cm^2$) and duration (3 or 14 days). Electrical conductivity and pH was measured in the APC residue suspension daily.

The results show that the pH development in the APC residue suspension was dependent on the type of APC residue and the experimental cell type, where the acidification of the suspension occurred earlier when using the two compartment setup and the acidification of the wet APC residue occurred earlier than for the semi-dry APC residue. The lowest final pH for the wet and semi-dry APC residues was 6.4 and 10.9, respectively. To obtain a high net removal of heavy metals from APC residues, lower pH are needed, however, this is very time consuming [3, 4].

On the other hand, the results obtained from this study showed that the leaching of Cd, Cu, Pb and Zn were reduced compared to the initial heavy metal leaching from the untreated residues, except when the pH was reduced to a level below 8 for the wet APC residues. Cr leaching increased after the electrodialytic treatment. Cl leaching from the APC residues was less dependent on experimental conditions and was reduced in all experiments compared to the initial levels.

The results further indicate that the new two compartment cell would be beneficial to reduce the remediation time for electrodialytic treatment of APC residues prior to possible reuse.

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